Electric Vehicle Charging Infrastructure at Maryland Rail Stations Study

Presentation to the
Electric Vehicle Infrastructure Council
November 13, 2013

PARSONS BRINCKERHOFF

Background

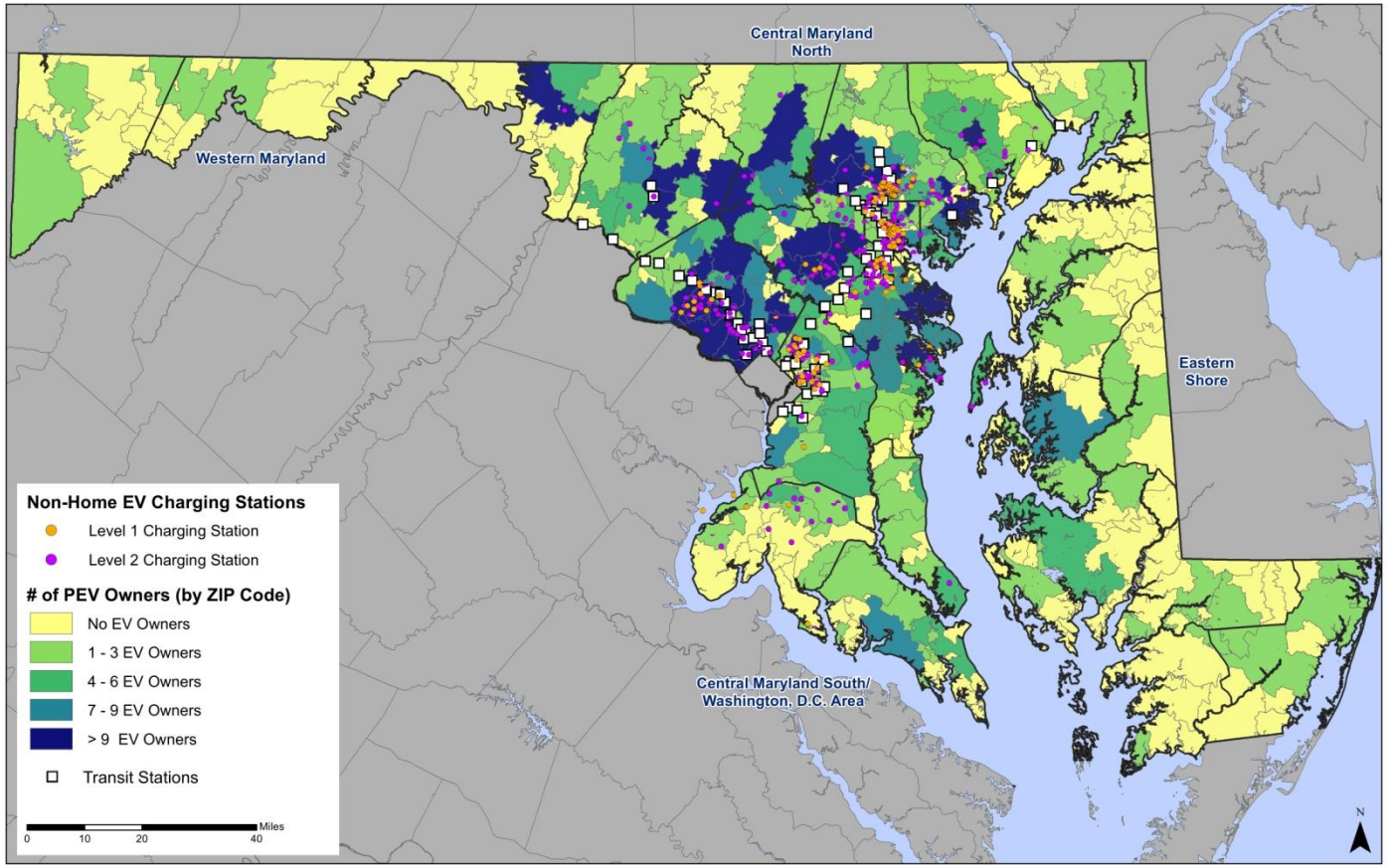
Background

- In 2012 the Maryland Electric Vehicle Infrastructure Council (EVIC) identified a target of 60,000 Electric Vehicles (EVs) registered in Maryland by 2020
- In report to Governor and Legislature - EVIC indicated a viable network of EV Charging Infrastructure is needed to encourage mainstream adoption of EVs in Maryland
- EVIC recommended installation of EV Charging units at State owned facilities
- EV Charging currently available at several State owned facilities

Background

- Maryland Energy Administration (MEA) secured $1,000,000 in funding to install EV Charging units at Maryland Rail Stations
  - Both MTA and WMATA Rail Stations can qualify for the MEA funding – stations under review include
    - 25 WMATA METRO Stations
    - 38 MARC Train Stations
    - 16 MTA Light Rail Stations
    - 7 MTA Metro Stations
  - Funds must be encumbered by end of FY'14 and spent by end of FY'15.

2013 Existing EVs & Charging Units in proximity to Rail Stations Statewide



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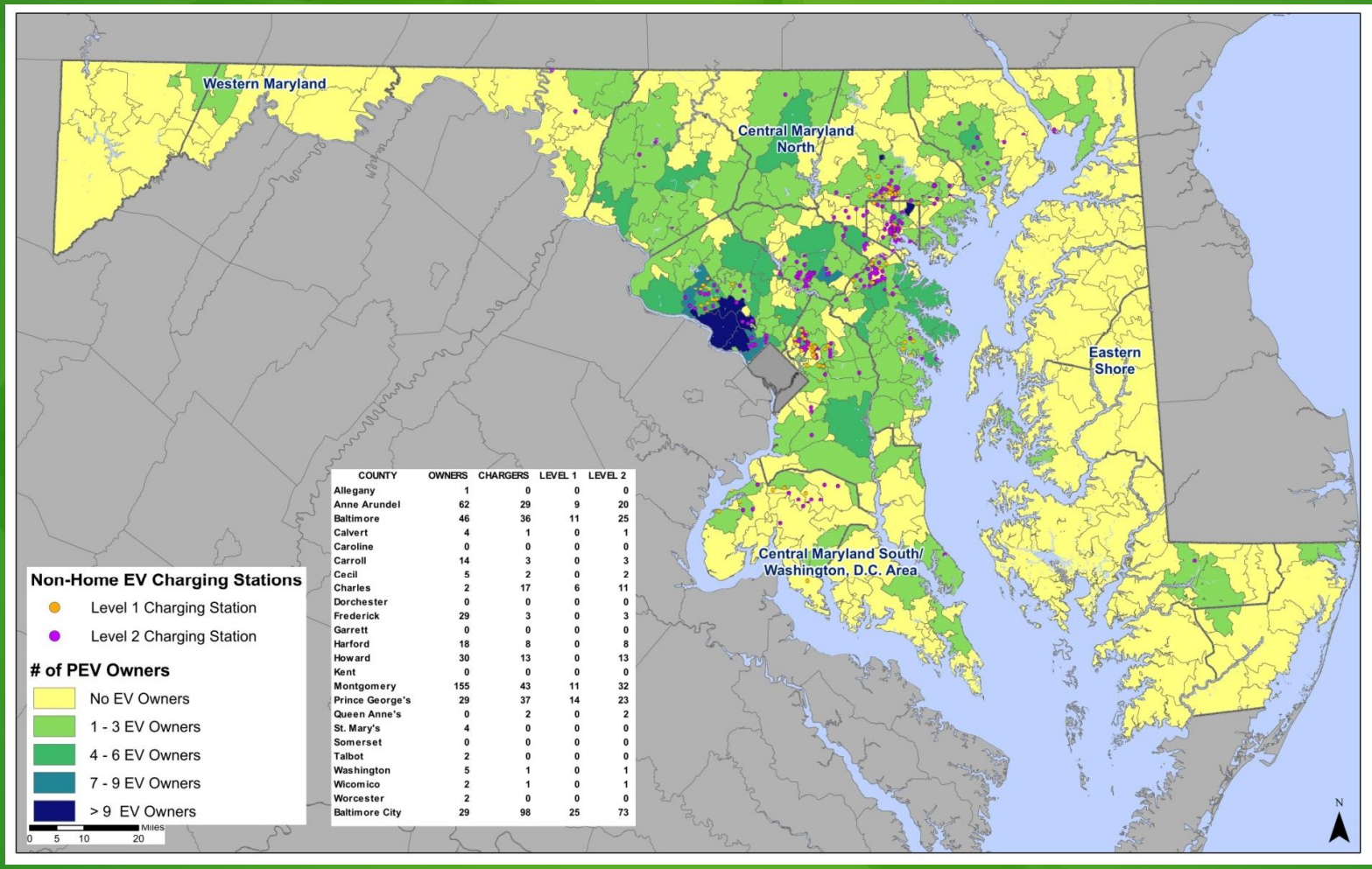
2012 Existing EVs & Charging Units Statewide



COUNTY	OWNERS	CHARGERS	LEVEL 1	LEVEL 2
Allegany	1	0	0	0
Anne Arundel	62	29	9	20
Baltimore	46	36	11	25
Calvert	4	1	0	1
Caroline	0	0	0	0
Carroll	14	3	0	3
Cecil	5	2	0	2
Charles	2	17	6	11
Dorchester	0	0	0	0
Frederick	29	3	0	3
Garrett	0	0	0	0
Harford	18	8	0	8
Howard	30	13	0	13
Kent	0	0	0	0
Montgomery	155	43	11	32
Prince George's	29	37	14	23
Queen Anne's	0	2	0	2
St. Mary's	4	0	0	0
Somerset	0	0	0	0
Talbot	2	0	0	0
Washington	5	1	0	1
Wicomico	2	1	0	1
Worcester	2	0	0	0
Baltimore City	29	98	25	73

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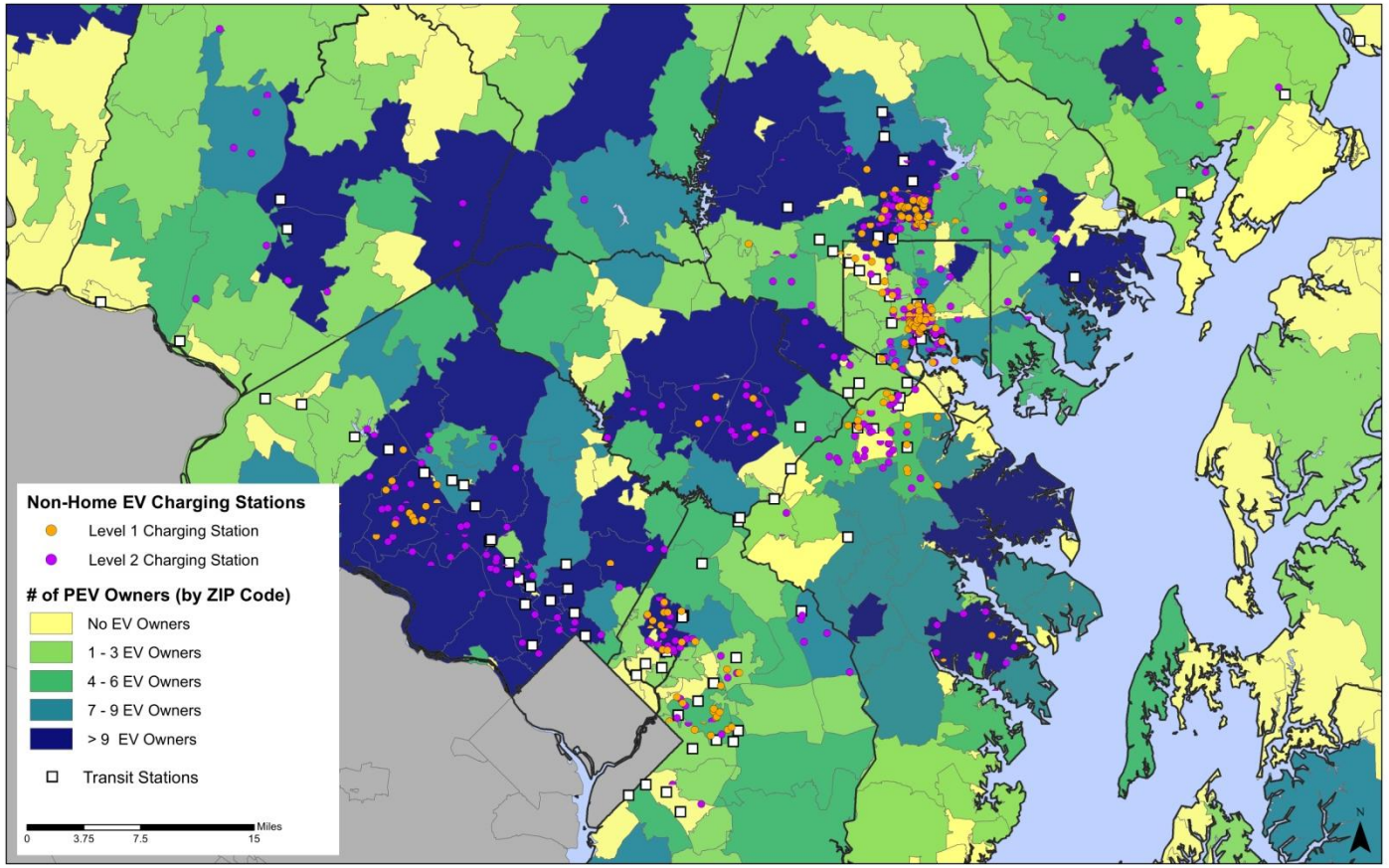
Existing EVs & Charging Units in proximity to Rail Stations in DC/Baltimore Area



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Study Approach & Demand Modeling

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Study Approach

- Building upon the EV Infrastructure Study this study identifies those transit stations with the highest demand for EV Charging units based on socioeconomic factors and travel patterns of transit passengers
- Cross functional usage of the EV Charging units was also examined – identifying those stations in closest proximity to major employment areas, multi-family dwellings, and retail and entertainment venues

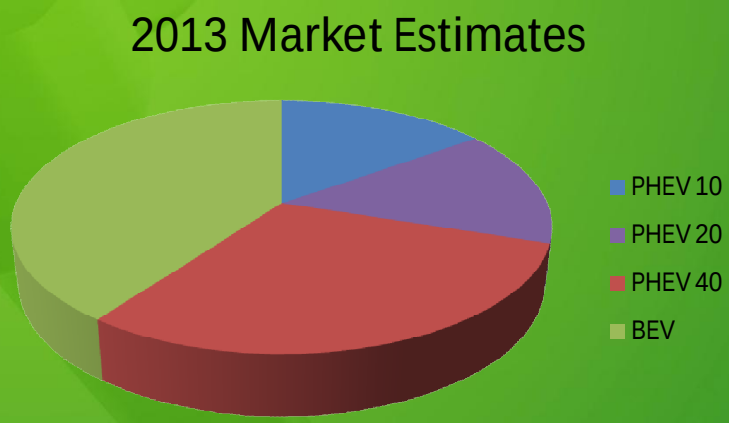
Demand Modeling

- The demand for charging is based on the following factors:
  - Market share distribution -likelihood to buy based on household income
  - Total car trips to the station per day (based on the travel demand model)
  - A distribution of the travel distance to the station (based on TAZ distance with some modeled variation in distance based on a chi-squared distribution)
  - An estimation of time parked at the station (imputed from trip purpose)

Demand Modeling

2012 Market Estimates	
Vehicle Type	Percentage of Market
PHEV 10	40%
PHEV 40	30%
BEV	30%

2013 Market Estimates	
Vehicle Type	Percentage of Market
PHEV 10	15%
PHEV 20	15%
PHEV 40	30%
BEV	40%



Demand Modeling – WMATA METRO Stations

Station Name	Station Rank	0-5 mile PEV trips	5-10 mile PEV trips	10-20 mile PEV trips	20-30 mile PEV trips	Over 30 mile PEV trips	Total number of PEVs	Demand for free low power chargers	Demand for free high power chargers	Low power charger demand for >5 mile trips	High power charger demand for >5 mile trips	Low power definite need for those likely to increase eVMT	High power definite need for those likely to increase eVMT	Potential QC users per day		2014 total number of PEVs	2014 demand for free low power chargers	2014 demand for free high power chargers	2014 low/high power charger demand for >5 mile trips	2014 high power definite need for those likely to increase eVMT
Shady Grove	1	287	45	18	17	14	381	282	22	87	7	39	5	1		19	14	1	5	2
New Carrollton	2	184	50	68	9	2	313	231	19	119	10	43	7	1		16	12	1	6	2
Branch Avenue	3	172	39	55	2	8	276	210	11	99	5	38	3	1		14	10	1	5	2
Greenbelt	4	119	21	56	1	2	199	146	13	74	6	29	3	1		10	7	1	4	2
Suitland	5	101	16	14	7	16	154	116	7	50	3	28	3	0		8	6	0	3	2
Largo Town Center	6	128	17	3	0	2	150	110	10	20	2	5	0	0		8	6	0	1	0
Southern Avenue	7	82	8	41	2	0	133	98	9	47	4	19	3	0		7	5	0	3	1
Glenmont	8	87	17	6	0	6	116	83	10	26	3	10	2	0		6	4	0	1	1
Grosvenor	9	83	5	2	0	0	90	62	10	6	1	1	0	0		5	3	1	0	0
Landover	10	46	15	12	3	0	76	60	1	29	1	10	0	0		4	3	0	2	1
Silver Spring	11	54	9	3	0	9	75	49	11	17	4	9	3	0		4	2	1	1	1
College Park - U of MD	12	60	7	5	0	0	72	50	8	10	2	3	0	0		4	2	0	1	0
Twinbrook	13	59	3	2	0	1	65	45	7	5	1	2	0	0		3	2	0	0	0
Wheaton	14	60	2	0	0	0	62	42	7	2	0	0	0	0		3	2	0	0	0
Prince George's Plaza	15	54	3	3	0	0	60	46	2	6	0	2	0	0		3	2	0	0	0
Forest Glen	16	56	1	0	0	0	57	40	6	1	0	0	0	0		3	2	0	0	0
Morgan Blvd	17	42	7	3	1	0	53	39	3	10	1	3	0	0		3	2	0	1	0
West Hyattsville	18	51	2	0	0	0	53	35	7	2	0	0	0	0		3	2	0	0	0
Rockville	19	30	3	0	2	14	49	35	4	17	2	14	3	0		2	2	0	1	1
Addison Road	20	43	3	2	0	0	48	34	4	5	0	1	0	0		2	2	0	0	0
Cheverly	21	40	2	0	0	0	42	31	2	2	0	0	0	0		2	2	0	0	0
Capitol Heights	22	29	1	5	0	0	35	27	1	6	0	2	0	0		2	1	0	0	0
Naylor Rd	23	29	2	1	0	0	32	23	2	3	0	1	0	0		2	1	0	0	0
Bethesda	24	21	1	4	0	3	29	18	6	6	2	4	2	0		1	1	0	0	0
White Flint	25	19	1	1	0	0	21	14	3	2	0	0	0	0		1	1	0	0	0
Friendship Hts*	26	17	1	2	0	0	20	13	3	2	1	1	0	0		1	1	0	0	0
Medical Center*	27	-1	0	6	0	1	6	4	1	6	1	3	0	0		0	0	0	0	0

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Demand Modeling – MTA Rail Stations – top 24

Station Name	Station Rank	0-5 mile PEV trips	5-10 mile PEV trips	10-20 mile PEV trips	20-30 mile PEV trips	Over 30 mile PEV trips	Total number of PEVs	Demand for free low power chargers	Demand for free high power chargers	Low power charger demand for >5 mile trips	High power charger demand for >5 mile trips	Low power definite need for those likely to increase eVMT	High power definite need for those likely to increase eVMT	Potential QC users per day		2014 total number of PEVs	2014 demand for free low power chargers	2014 demand for free high power chargers	2014 low/high power charger demand for >5 mile trips	2014 high power definite need for those likely to increase eVMT
OWINGS MILLS	1	20	7	8	6	1	42	27	7	19	3	9	2	0		2	1	0	1	1
UNION STATION **	3	6	0	2	5	4	17	11	3	10	1	8	2	0		1	1	0	1	0
ODENTON	4	4	2	3	1	0	10	6	2	5	1	2	0	0		1	0	0	0	0
MILFORD MILL	5	6	2	1	0	0	9	6	1	3	0	1	0	0		0	0	0	0	0
OLD COURT	6	5	1	1	0	0	7	4	1	2	0	1	0	0		0	0	0	0	0
NORTH LINTHICUM	7	1	1	3	1	0	6	0	0	3	1	2	1	0		0	0	0	0	0
BRUNSWICK	8	5	1	0	0	0	6	4	1	1	0	0	0	0		0	0	0	0	0
TIMONIUM FAIRGROUNDS	9	4	1	1	0	0	6	4	1	2	0	0	0	0		0	0	0	0	0
REISTERSTOWN PLAZA	10	4	1	0	0	0	5	1	0	1	0	0	0	0		0	0	0	0	0
GERMANTOWN	11	4	1	0	0	0	5	3	1	1	0	0	0	0		0	0	0	0	0
MT WASHINGTON	12	4	1	0	0	0	5	3	1	1	0	0	0	0		0	0	0	0	0
PENN STATION	13	5	0	0	0	0	5	3	1	0	0	0	0	0		0	0	0	0	0
POINT OF ROCKS	14	1	1	2	1	0	5	3	1	4	0	2	0	0		0	0	0	0	0
BOWIE STATE UNIV	15	3	1	0	0	0	4	3	1	1	0	0	0	0		0	0	0	0	0
BWI AIRPORT	16	2	1	1	0	0	4	3	1	2	1	0	0	0		0	0	0	0	0
DORSEY	18	2	1	1	0	0	4	3	1	2	0	1	0	0		0	0	0	0	0
MUIRKIRK	19	3	1	0	0	0	4	3	1	1	0	0	0	0		0	0	0	0	0
EDGEWOOD	21	3	0	0	0	0	3	2	0	0	0	0	0	0		0	0	0	0	0
LAUREL	22	3	0	0	0	0	3	2	0	0	0	0	0	0		0	0	0	0	0
ROCKVILLE	23	0	0	1	1	1	3	2	0	3	0	2	0	0		0	0	0	0	0
WEST COLD SPRING	24	2	0	0	0	0	2	0	0	1	0	0	0	0		0	0	0	0	0
HALETHORPE	25	2	0	0	0	0	2	1	0	0	0	0	0	0		0	0	0	0	0
LUTHERVILLE	27	2	0	0	0	0	2	1	0	0	0	0	0	0		0	0	0	0	0
SAVAGE	28	1	0	1	0	0	2	1	0	1	0	0	0	0		0	0	0	0	0

Implementation Considerations

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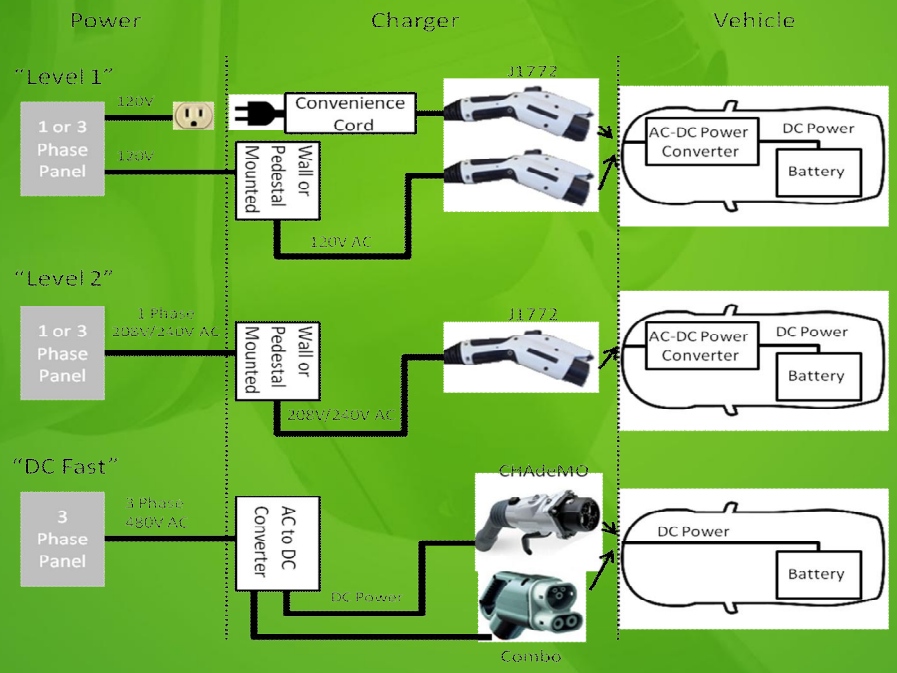
Implementation Considerations – Charging Infrastructure

Common Charging Categories and their connectors



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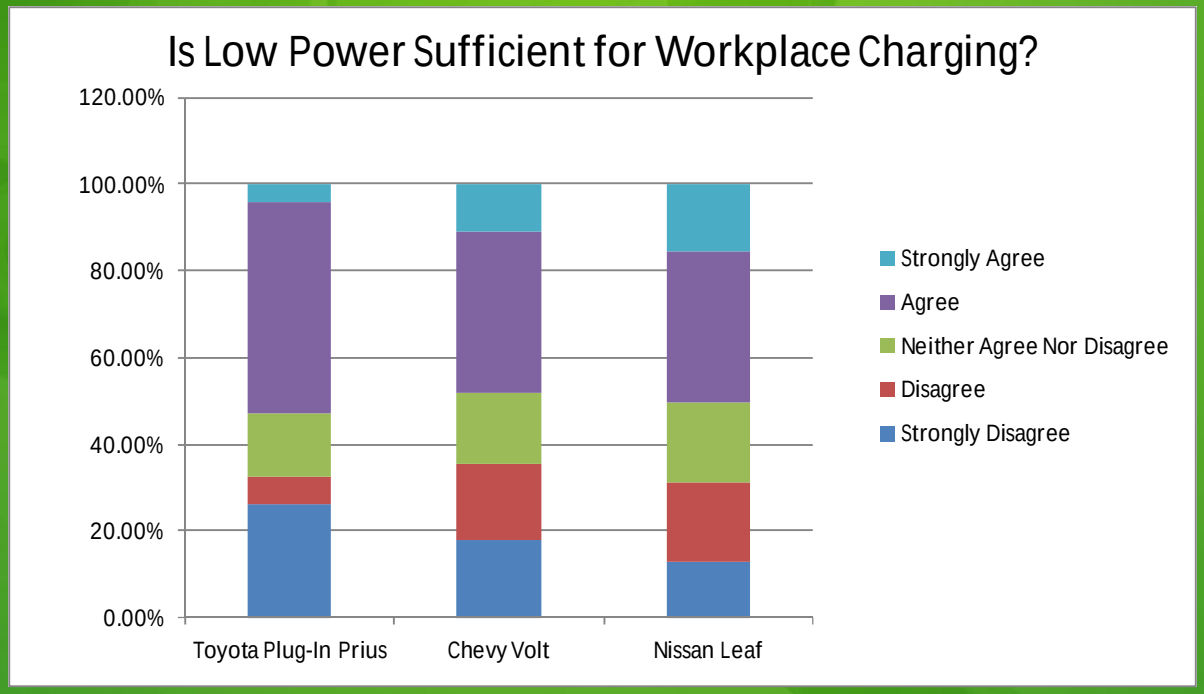
Implementation Considerations – Low Power Charging is Sufficient for Most Vehicles

- Analysis has shown that the use of low power chargers is sufficient for commuters using PHEVs for most trips and for 80 percent of BEVs charging events



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Implementation Considerations – Charging Times for Various Vehicles

Charging Level	EVSE Charger Power	Miles Gained/Hour				
		Plug-in Prius	Chevrolet Volt	Ford C-Max Energi	Nissan Leaf	Tesla Model S
Level 1 120V AC	1.4kW	3-5 mi	3-5 mi	3-5 mi	3-5 mi	3-5 mi
Level 2 208V-240V AC	1.4kW	3-5 mi	3-5 mi	3-5 mi	3-5 mi	3-5 mi
	3.3kW	6 mi	10 mi	10 mi	10 mi	10 mi
	6.6kW	6 mi	10 mi	10 mi	20 mi	20 mi
	10kW	6 mi	10 mi	10 mi	20 mi	30 mi
DC Fast Charger 200-400V DC	50 kW	x	x	x	65 mi in 30 minutes	130 mi

Implementation Considerations – Pricing of Charging Facilities

- Free charging is effective at encouraging the sales of electric vehicles and, at transit stations, patronage of transit
  - Pros of Free Charging at Transit Stations
    - Increases attractiveness of transit
    - Simplifies charger installation and setup
    - Avoids administrative hassle of collecting revenue
    - Avoids impression of pettiness since electricity is cheap
    - Provides benefit to transit riders, employees, shoppers, and residents
    - Creates a green image
  - Cons of Free Charging at Transit Stations
    - Switches charging from home to the transit station
    - Other riders subsidize the cost of electricity
    - Does not appreciably increase eVMT over a priced scenario
    - Creates congestion at chargers more quickly than a priced scenario
    - Decreases dependability for BEVs, discouraging certain trips
    - Potentially requires expensive panel upgrades to keep up with demand
    - Demand for free chargers may outpace practical installation rates

Implementation Considerations – Hardware Installation and Operations Costs

Cost Category*	Low Power (<2kW)		High Power Level 2 (>3.3kW)		Examples
	Low	High	Low	High	
Permitting	$200	$1,000	$200	$1,000	
EVSE	$500	$1,000	$500	$5,000	Clipper Creek, Chargepoint, GE
Monitoring/Payment *	$4/mo	$20/mo	$6/mo	$20/mo	Chargepoint, Liberty Plug ins, eMonitor, Brultech
Engineering	$500	$10,000	$1,000	$10,000	
Installation	$500	$5,000	$700	$5,000	
Trenching	$2,000	$10,000	$2,000	$10,000	

*Cost is per EVSE. Some costs can be combined such as concrete trenching for many EVSE.
*Monitoring agreements for large contracts can be negotiated.

Implementation Considerations – Hardware Installation and Operations Costs

- Many businesses opt to install high capacity Level 2 (6.6kW) due to short duration parking events
- Transit stations, which have longer duration parking times, have the option to install low power charging with the benefit of lower per unit cost and the avoidance of costly panel and service upgrades
- Monitoring can be done through the charging unit with software from a service provider such as Chargepoint or SemaConnect, or through monitoring equipment installed in the electricity panel

Implementation Recommendations

Implementation Recommendations

- Installation is recommended in phases based on the station ranking and the actual demand for the first two chargers in each location; by monitoring demand, future adjustments can be made
- In years 1-2 estimations are broken up in to chargers and planned expansion (electrical stubs)
- A mix of high and low power is desirable in general to increase flexibility
- In the first years, those transit stations with low demand should focus exclusively on high power chargers

Implementation Recommendations – Top 30 Short-term Recommendations

Station Name	2014/2015 High power recommendation	2014/2015 Secondary location	2014/2015 EVSE Ready Spots
Owings Mills	4	4	8
New Carrollton	4	4	6
Shady Grove	4	4	4
Branch Avenue	4	4	2
Greenbelt	4	2	2
Odenton	2	2	2
Milford Mill	2	0	2
Suitland	2	2	4
Largo Town Center	2	2	4
Old Court	2	0	2
North Linthicum	2	0	2
Brunswick	2	0	0
Timonium Fairgrounds	2	0	2
Southern Avenue	2	2	0
Glenmont	2	0	2
Grosvenor	2	0	2
Silver Spring	2	0	2
Landover	2	0	2
Germantown	1	0	2
Mt Washington	1	0	2
Penn Station	1	0	1
Point Of Rocks	1	0	1
Edgewood	1	0	1
Bowie State Univ	1	0	1
BWI Rail Station	1	0	1
Dorsey	1	0	1
Muirkirk	1	0	1
Laurel	1	0	1
West Cold Spring	1	0	1
Halethorpe	1	0	1

Implementation Recommendations – Top 30 Mid & Long-term Recommendations

Station Name	2020 High power	2020 Low power / Secondary location	2025 High power paid	2025 Low power
Owings Mills	6	8	10	12
New Carrollton	4	8	8	12
Shady Grove	4	8	8	10
Branch Avenue	4	6	6	10
Greenbelt	4	4	6	8
Odenton	4	4	8	8
Milford Mill	2	2	4	6
Suitland	4	4	4	6
Largo Town Center	4	4	6	6
Old Court	2	2	2	4
North Linthicum	2	2	2	4
Brunswick	2	2	2	4
Timonium Fairgrounds	2	0	2	4
Southern Avenue	4	2	4	4
Glenmont	2	2	2	4
Grosvenor	2	2	4	4
Silver Spring	2	2	2	4
Landover	2	2	2	2
Germantown	2	2	2	2
Mt Washington	2	0	2	2
Penn Station	2	0	2	2
Point Of Rocks	2	0	2	2
Edgewood	2	0	2	2
Bowie State Univ	2	0	2	2
BWI Rail Station	2	0	2	2
Dorsey	2	0	2	2
Muirkirk	2	0	2	2
Laurel	2	0	2	2
West Cold Spring	2	0	2	2
Halethorpe	2	0	2	2

Implementation Recommendations – Cross Functional Usage

- To integrate the EVIC's recommendation to the Governor and Legislature "to add charging infrastructure at State facilities in underserved areas", cross functional usage of EVSEs at transit stations was examined during this study

Implementation Recommendations – Cross Functional Usage

	Factors	Weight	Rating	Weighted Score
1	Usage of transit station by customers whose trip originates in a TAZ with high current or anticipated EV Ownership	0.4		
2	Close proximity to major employer	0.2		
3	Close proximity to multi-family dwellings	0.2		
4	Close proximity to entertainment venue	0.08		
5	Close proximity to retail	0.12		
	Total	1		

New Carrollton (MARC/WMATA METRO) Ancillary Factors Evaluation Matrix

	Factors	Weight	Rating	Weighted Score
1	Usage Demand Score	0.4	4	1.6
2	Close proximity to major employer	0.2	4	0.8
3	Close proximity to multi-family dwellings	0.2	2	0.4
4	Close proximity to entertainment venue	0.08	1	0.08
5	Close proximity to retail	0.12	1	0.12
	Total	1		3

Implementation Recommendations – Cross Functional Usage 30 Highest Ranking Stations

Station Rank	Station Name	Factor Score	Mode	Parking Owner
1	Silver Spring	3.6	MARC/WMATA	Montgomery County
2	Wheaton	3.6	WMATA	WMATA
3	Owings Mills	3.48	Metro Subway	MTA
4	Rockville	3.48	MARC/WMATA	WMATA
5	Largo Town Center	3.4	WMATA	WMATA
6	Prince George's Plaza	3.4	WMATA	WMATA
7	White Flint	3.32	MARC	WMATA
8	Mt. Washington	3.2	LR	MTA
9	Glenmont	3.16	WMATA	WMATA
10	Twinbrook	3.16	WMATA	WMATA
11	Suitland	3.12	WMATA	WMATA
12	Branch Avenue	3	WMATA	WMATA
13	Germantown	3	MARC	MTA/Montgomery County
14	Hunt Valley	3	LR	MTA
15	New Carrollton	3	MARC/WMATA/Amtrak	WMATA/AMTRAK
16	Timonium	2.96	LR	Baltimore County
17	Gaithersburg	2.88	MARC	City of Gaithersburg
18	Bethesda	2.8	WMATA	Montgomery County
19	College Park	2.76	MARC/WMATA	WMATA
20	Grosvenor	2.76	WMATA	WMATA
21	Penn Station	2.76	MARC/AMTRAK	AMTRAK
22	West Hyattsville	2.76	WMATA	WMATA
23	Brunswick	2.72	MARC	CSX
24	Shady Grove	2.72	WMATA	WMATA
25	Laurel	2.68	MARC	MTA
26	Reisterstown Plaza	2.64	Metro Subway	MTA
27	Frederick	2.6	MARC	City of Frederick
28	Aberdeen	2.56	MARC	AMTRAK
29	Kensington	2.56	MARC	CSX
30	Forest Glen	2.52	WMATA	WMATA

Monitoring and Usage

Monitoring and Usage of EVSEs

- A monitoring and usage plan to track usage of EV Chargers at transit stations in Maryland is an important element in ensuring success of the EV charging network
- Monitor the level of usage at the various locations to determine demand and need for expansion
  - Where to add EVSEs and at what power level
- Monitor who is using the EVSEs and for what purpose
  - Commuter
  - Local resident (multi-family dwelling)
  - Visitor to local business, retail, entertainment venue

Utilization Factor	Measuring Unit	Comments
Network characteristics		
Number of EVSE installed by power Level per location	Number of chargers by kW and charging type (L1, L2, QC) and standard (J1772, CHAdeMO, Combo, Tesla, other)	Most Chargers should be Level 2 J1772 either low power (<1.5kW) or high power (>1.5kW)
Number of parking spots available that can be used to connect to the EVSEs	Designated EV Undesignated Handicapped	Some spaces can be used by EVSE even though they are not designated as such
Parking Type	Reserved Paid Free	
Cost	Cost per connection Cost per hour Cost per kW Cost per parking event in EV parking place	
Usage data		
Number of PEVs parking at EVSE locations per day	Based on plug in vehicles that park next to chargers	May require loop detectors or periodic monitoring by transit personnel
Number of PEVs that plug in to chargers and time plugged in	Time between plugging in and plugging out	Monitored by EVSE or submeter
Number of hours charging	Based on time when car is requesting power	Monitored by EVSE or submeter
Total kWh dispensed per charging event and per charger	In kWh per charging event and per EVSE	Monitored by EVSE or submeter
Total amount paid per charging event	Dollars	Various collection methods. EVSE manufacturers payment system, external payment system
Peak power used	In kW to test the match between the equipment power and the vehicle power need	Monitored by EVSE or submeter
Power at plug-out event	In kW to measure if plugged out full or while charging	Monitored by EVSE or submeter
Trip Purpose Data		
Transit users parking PEVs at the station	Number of users	Periodic Survey
Kiss and ride PEVs	Number of users	Periodic Survey
Non-transit PEVs using the parking garage	Number of users	Periodic Survey
Trip distance of 1,2,3		Periodic Survey

Questions?

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